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Using elephants to track rhinoceros poachers

– J G du Toit

CHAPTER 29

Using elephants to track rhinoceros poachers. - J.G. du Toit

Elephants have the best-developed olfactory system of all mammals. It is hypothesized that elephants make use of both air and ground scent in order to detect odour, although their ability to detect air scent is much better evolved than any other mammalian as a result of an elongated trunk that can be moved around in the air even up to six meter above ground level. This ability of elephants was applied together with dogs in the technique known as remote explosive scent tracing (REST). The ability of elephants to detect chemical particles was applied to train them detecting landmines, weapons, tracking poachers and rhinoceros horn. This unique concept was done by the ZZ2 Company in South Africa.

The use of dogs as chemical detectors dates back to their use as hunting dogs almost 12 000 years ago. The civilian use of canines began with tracking individuals and locating drugs and bombs and has expanded to include a large number of applications. The detector dog and its handler remain the most widely used, broadly sensitive, accurate, fast, mobile, flexible and durable system available for detecting illegal drugs and explosives or any other volatile substance. Due to the exquisite sensitivity of the canine olfactory system, dogs can detect minute concentrations of volatile chemical substances in the environment. The scientific basis of this technology is underdeveloped, in spite of the availability of relevant and well-established scientific literature. Furthermore there are a number of limitations utilizing dogs in the detection of explosives, like landmines in the field, which include dogs tire easily and is only able to work a few hours per day, can be easily infected from the environment and their scent is limited in thick vegetation. For these reasons the objective of the research project was to investigate the scientific foundation for the utilization of the scent potential of the elephant to assist in the detection of volatile substances. The hypothesis is that elephants will improve the working capacity of canines in the field since elephants evolved for millions of years without domesticated influences relying on their ground scent ability from different odours like faeces, saliva, fluids from the temporal gland and genital openings to communicate with each other on a chemical basis.

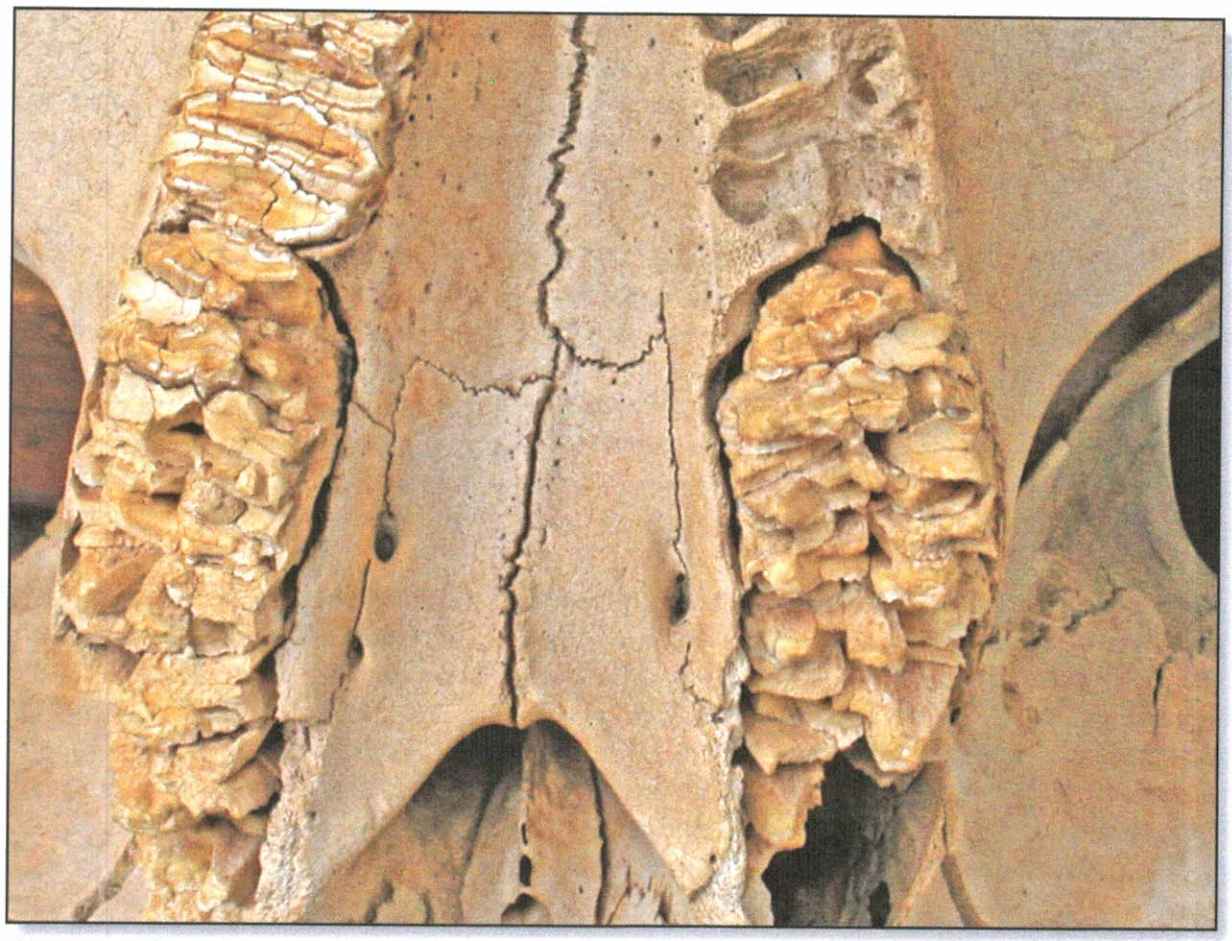
The vertebrate olfactory bulb is the site of extensive neural processing of primary olfactory inputs. The elephant has a highly developed chemosensory system, which includes both the primary olfactory and the vomeronasal organ systems. A small recess, the vomeronasal organ, is located in the dorsal anterior part of the mouth. The paired orifices of the vomeronasal organ lead into the anterior mucous-filled respiratory epithelium region, which connects with the neuro-epithelial, the region of the primary olfactory system. The trunk on the other hand is a unique apparatus that the elephant can use to isolate and humidify compounds and brings it in direct contact with the vomeronasal organ. The vomeronasal organ in the canine on the other hand is located as an elongated flattened fold at the cephalic end of the nose just above the palate. The small cephalic end passes ventral to the incisors and open into the

ductus naso-palatinus, which lead from the oral to the nasal cavity. The nerve supply to the vomeronasal organ in the dog is from two different sources, the Olfactory nerve (N 1) and the Trigeminal nerve (N 5). Knowledge surrounding the anatomy of the vomeronasal organ in the elephant is limited, which necessitate investigation in order to explain and understanding the mechanism of scent tracing of elephants on a cellular and molecular level.

The mechanism of odour recognition in elephants can be explained at the hand of two well-studied examples, the one elephant bulls in musth, the other recognition of the young by their mothers. In the first example the elephant bull will place its trunk tip over a urine spot on the ground of a female in oestrus. After aspiration of the air above the urine spot, if sufficient odour stimulus is present, the bull will curl the trunk tip towards and inserted it into its mouth. The trunk tip presses against the twin orifices of the vomeronasal organ directly transferring an air sample. In the second example ample scientific evidence indicated that ewes use their vomeronasal organ for the recognition of their lambs.

The use of elephants in the detection of substances has some advantages to the use of canines, which prone them better as biological detectors. Firstly, elephants are not domesticated in comparison to dogs which were mans companion through the ages. Therefore, elephants will be more prone to domesticated scents. Joyce Pool observed elephants in Amboseli sensing and running away from Masai warriors at a distance of two kilometers because these Masai warriors used to spear the animals. An elephant bull was witnessed in the Etosha National Park detecting a female in oestrus at a distance of 17 km. Hunters observed elephants detecting water up to 5 km from the source. The question of how these animals detect the "correct smell" between the different odours it gets bombarded from the environment is not yet known.

Secondly, the smelling capacity of elephants is hypothesized to be more effective than that of canines since the trunk is utilized to consolidate compounds in air scent. The elephant is capable to elevate its trunk several meters above ground level, which increase its chances to pick up scent from rafts blowing by. The trunk can also be utilized to detect odorous substances at ground level and bring it in contact with the vomeronasal organ in the palatinal area. In canines the ability of their olfactory system to detect scents or odorous substances on a raft can be explained by the length of the nose. In general, the longer the nose of the dog the larger the area for important receptor cells, utilized to analyze scents. A Fox Terrier for example with its shorter nose contains approximately 147 million receptor cells while the larger German Shepherd with its longer nose has approximately 225 million receptor cells. Similar the primary olfactory system of the much larger elephant is expected to contain a large number more of these important scent detecting receptor cells. In mathematical terms the odorous substance detecting sensitivity can be explained in the following way. A human can smell substances in concentrations of approximately one part per million. The best chemical analyzers can detect concentrations of about one part per billion. In contrast to this canines has been observed to have the ability to sense volatile substances at concentrations of approximately a tenth of one part per trillion. It is hypothesized that the olfactory system of elephants has an even larger sensitivity.



Two openings in the palate of the elephant that traps particles to be transferred to the vomeronasal organ

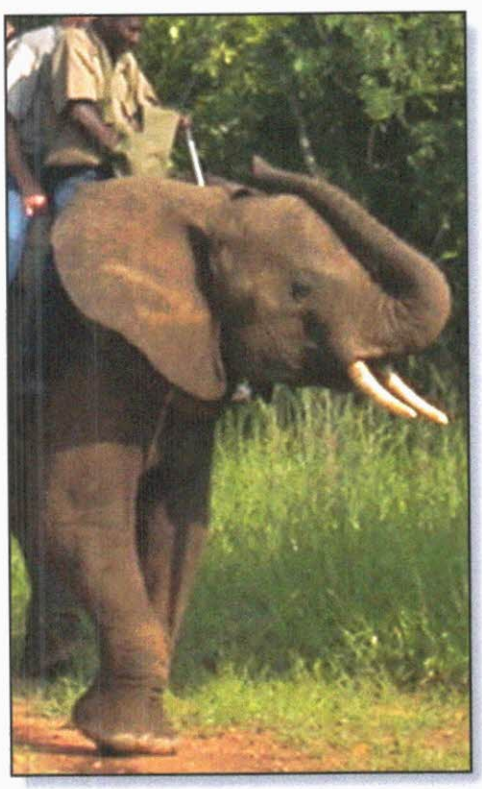
Thirdly, except for its superior olfactory ability, elephants are more "intelligent" than canines and it can be assumed that they will learn much faster than any other animal species. Fourthly, the working lifespan of an elephant is seven times longer than a dog. An elephant is expected to live approximately 42 years versus the 6-year lifespan of canines. Taking into consideration that training start at an age six months and the dog is ready for field use at one year. This leaves a period of 2 to 3 years for application in the field. Fifthly, elephants are not easily prone to diseases from the natural environment that may influence their scent detection capacity as with canines. Dogs olfactory region are prone to infection by a bacteria from the environment causing babesiosis that may result in the total destruction of their scent detection ability. Although a canines natural scenting ability is more easily adapted to vegetative scent dogs are limited in their ability to detect scent in thick vegetation. Elephants on the other hand are herbivores and will detect volatile substances easier than dogs from samples taken from these areas. Finally, elephants are better adapted to different environmental conditions and are found from the desert landscapes in the Kaokoveld to the forests in Knysna.

Despite these advantages of the use of elephants as bio-detectors have some limitations that need to be overcome in order to utilize them to their full potential in volatile substance detection. Elephants are large animals, which make them logistically difficult to work with,

and their maintenance cost will be much higher in comparison with dogs. Elephants also get excited very easy by strange stimuli from the environment that will make them unsuitable to take into mine fields for example. These limitations needs to be known and understood completely in order to take the necessary steps of limiting these confines.

Similar to canines, detector elephants can potentially be applied in the detection of volatile substances in a vast number of disciplines. The applications include the medical field, biological and chemical contamination of the environment, presence of pesticides in the food import and export industry, military and policing, civilian uses. In the medical field these animals can be applied in the detection of cancers, infectious diseases like tuberculosis, malaria, etc. and even in metabolic disorders like diabetes mellitus. Although, sensitive analytical techniques used in odour identification include gas chromatography mass-spectrometry (GC-MS) and electronic "nose" technology, these technologies are expensive and not 100% accurate. A biological method of even higher sensitivity than the chemical methods exist for detecting volatile organic compounds (VOCs) and is found is the scent detection ability of trained mammalians like canines, rats or elephants. Pilot successes using a dog's scent ability in cancer detection suggest that the highly sensitive mammalian olfactory system may hold the key for the development of a highly effective cancer or infectious disease detector. This application may be a reality for people in rural areas that cannot afford expensive medical treatment, to test by elephants for diseases like tuberculosis.

In policing and military application detector elephants can be applied by preference to dogs in the detection of rhinoceros horn, ivory, drugs, arms, bombs and other illegal substances and drugs (**Refer to Table 29.1**). Identify the location of landmines, biological weapons, finding wounded troops in the bush and excavate them out of difficult terrain are all useful application that comes to mind in the use of detector elephants mine infested areas can be identified and cleared to make it safe. The introduction of elephants in minefields and teach the matriarch before the time to avoid these areas. Farmers with problems with stock theft can make use of detector elephants to follow the scent "spoor" of cattle. These elephants may also be used to help in the search of people that drowned in dams or rivers.



Elephant salutes – detecting the smell of a landmine

In the trade and industry elephants can be employed to detect the illegal importation of food, animals, etc. They can also help to detect pesticide contamination or even bacterial or fungal contamination of food resulting in the food not suitable for human consumption. In a similar manner the well-trained elephant can identify water or food sources that are toxic and unfit for human consumption in rural or poor African countries.

Table 29.1: Biodetectors - Comparison between elephant and dog

CHARACTERISTIC	ELEPHANT	DOG
Environmental effects		
Mobility to operational area	Specialised transport equipment	No special transport equipment
	needed	needed
Mobility in operational area	Very mobile - cross rivers easily	Less mobile
Climatic conditions		
High temperatures	Can work above 30° C	Cannot work above 30° C for long
		periods
Disease susceptibility	No disease effect from	Babesia and Rickettsia cause illness
	environment	
Time of day	Can work at night - full moon	Operators cannot work at night
Financial factors		
Transport costs	More expensive	Less expensive
Training costs	Same time but feeding costs higher	Same time but feeding costs lower
Maintenance costs	Housing costs more expensive	Housing costs less expensive
	Can feed from environment	Cannot feed from environment
Animal factors		
Operational speed	Catch up time 30% - human on foot	Catch up time the same as human on foot
Operational time	6-8 hours a/day	4-6 hours/day
Trainability	Not all elephants are trainable	Related to species and animal
Interaction with other animals	No problems with wild animals	Predators can catch dogs
Lifespan – working years	42 years	6 years
Human factors		
Psychological Effectiveness	High effect on poachers	Low effect on poachers
Fitness of handlers	Handler can ride elephant	Handlers get more tired - must walk with dog

Although a large spectrum of applications of elephants as bio-detectors is possible, this investigation proposes the development of the detector elephant system in to domain applications, a medical and a non-medical discipline. The elephants at ZZ2 were trained over a year period to detect rhinoceros horn, weapons and landmines. The elephants can also identify the carrier of the horn. Why can elephants not be used in anti-poaching operations?

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International mine action standards:

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IMAS 09.40 – Guide for the use of mine detection dogs.
IMAS 09.41 – Operational procedures for mine detection dogs.
IMAS 09.42 – Licensing of mine dogs.
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